

WHAT IS CLAIMED IS:

1. A process for the preparation of water soluble polypyrrole comprising admixing pyrrole, water, and an effective amount of an electroinactive water soluble polycation to form an initial composition, admixing said initial
5 composition with an effective amount of an oxidizer compatible with said pyrrole over a sufficient time and temperature effective to form a reacting composition so as to determine the potential thereof, and allowing said reacting composition to react for a time sufficient until substantially no decrease in potential occurs,
10 whereby said soluble polypyrrole is formed.
2. The process of Claim 1 wherein said initial composition is cooled to a temperature in the range from about 0 °C to about 25° C.
- 15 3. The process of Claim 1 where said polypyrrole formed is removed from said reacted composition.
4. The process of Claim 1 wherein said admixing is carried out in a controlled manner.
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5. The process of Claim 1 wherein an oxidizing agent is admixed in said initial composition.
6. The process of Claim 1 wherein said electroinactive water
25 soluble polycation is a quaternary cation.
7. The process of Claim 6 wherein said polycation comprises one or more polydiallyldimethylammonium salts.
- 30 8. The process of Claim 7 wherein said polydiallyldimethylammonium salts are selected from a group of organic and

inorganic and inorganic anions and acetate and inorganic anions consisting of p-toluenesulfonate, benzenesulfonate, methanesulfonate, bromide, chloride, tetrafluoroborate, hexafluorophosphate and fluorosulfonate.

5 9. The process of Claim 6 wherein said polycation comprises one or more poly(2-vinylpyridinium)salts.

10 10. The process of Claim 9 wherein said poly (2-vinylpyridinium) salts are selected from a group of organic and inorganic anions consisting of p-toluenesulfonate, benzenesulfonate, methanesulfonate, acetate, bromide, chloride, tetrafluoroborate, hexafluorophosphate, fluorosulfonate, and the like.

15 11. The process of Claim 6 wherein said polycation comprises one or more poly (4-vinylpyridinium) salts.

20 12. The process of Claim 11 wherein said poly(4-vinylpyridinium)salts are selected from a group consisting of 1-methyl-4-vinylpyridinium trifluoromethane sulfonate, poly(4-vinyl-1-pyridinium) salts, poly(methacrylamidopropyltrimethylammonium salts), poly(4-vinylbenzyltrimethylammonium, and the like.

25 13. The process of Claim 1 wherein said step of admixing pyrrole and water is at a pH in the range of about 0.1 to about 6.

 14. The process of Claim 13 wherein said pH is in the range from about 0.2 to about 2.

30 15. The process of Claim 1 having a concentration of pyrrole to anion from about 0.1% w/w to about 8% w/w.

16. The process of Claim 15 wherein said concentration is from about 2% w/w to about 6%w/w.

17. The process of Claim 16 having a ratio of pyrrole to oxidant
5 in equivalents of about 4/1 to about 1/4.

18. The process of Claim 17 wherein said ratio is in the range from about 2/1 to about 1/3.

19. The process of Claim 1 having a weight ratio of said pyrrole to said water soluble polycation from about 15/1 to about 1/10.

20. The process of Claim 19 wherein said ratio is from about 10/1 to about 1/10.

21. The process of Claim 1 wherein the water soluble polycation is a quaternary ammonium polymer.

22. The process of Claim 21 wherein said quaternary ammonium polymer has a molecular weight in the range from about 5000 to about 500,000.

23. The process of Claim 22 wherein said quaternary ammonium polymer has a molecular weight in the range from about 50,000 to about 400,000.

24. The process of Claim 3 wherein the removal of water soluble polypyrrole from said reacted composition is accomplished by admixing acetone to said reacted composition.

25. The process of Claim 24 having a ratio of reaction composition to said acetone in the range from about 1/1 to about 1/10.

26. The process of Claim 25 wherein said ratio is in the range
5 from about 1/2 to about 1/5.

27. The process of Claim 1 wherein the water soluble polypyrrole formed has an electrical conductivity in the range from about 10^0 to about 10^{-5} S/cm.
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28. The water soluble polypyrrole of Claim 27 wherein said electrical conductivity is in the range from about 10^{-1} to about 10^{-4} S/cm.

29. The process of Claim 1 wherein said water soluble
15 polypyrrole is in powder form.

30. The process of Claim 29 wherein said powder form can be redissolved in water with agitation.

20 31. The process of Claim 3 wherein the water soluble polypyrrole in powder form.

32. The process of Claim 31 wherein said powder form can be redissolved in water with agitation.
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33. A water soluble copolymer of pyrrole, or derivatives thereof, prepared by the process of Claim 1.

34. A water soluble copolymer of homopolymer of substituted
30 pyrrole, or derivatives thereof, prepared by the process of Claim 2.

35. A water soluble copolymer of polypyrrole prepared by the process of Claim 3.

36. A water soluble copolymer of polypyrrole having an
5 electrical conductivity in the range from about 10^0 to about 10^{-5} S/cm.

37. The water soluble copolymer of polypyrrole of Claim 32 wherein said electrical conductivity is in the range from about 10^{-1} to about 10^{-4} S/cm.

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38. A process for exchanging a dopant on a water soluble polypyrrole having an electrical conductivity in the range from about 10^{-8} S/cm to about 10^0 S/cm.

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39. The process of Claim 34 wherein said polypyrrole has an electrical conductivity from about 10^{-4} S/cm to about 10^{-1} S/cm.

40. The process of Claim 33 wherein the water soluble polypyrrole is in powder form.

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41. The process of Claim 35 wherein the water soluble polypyrrole is in powder form.

42. The process of Claim 40 wherein said powder form can be
25 conveniently redissolved in water with adequate agitation.

43. An article of manufacture comprising a water soluble polypyrrole having an electrical conductivity in the range from about 10^{-8} S/cm to about 10^0 S/cm and a bound dopant anion.

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44. The article of manufacture of Claim 43 wherein said polypyrrole has an electrical conductivity from about 10^{-4} S/cm to about 10^{-1} S/cm.

45. A water soluble polypyrrole having an electrical
5 conductivity in the range from about 10^0 to about 10^{-5} S/cm.

46. The water soluble polypyrrole of Claim 45 said electrical conductivity is in the range from about 10^{-1} to about 10^{-4} S/cm.

10 47. The water soluble polypyrrole of Claim 45 further comprising a copolymer.

48. The water soluble polypyrrole of Claim 46 further comprising a copolymer.
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49. A process for making a water insoluble film cast for a water soluble polypyrrole comprising solubilizing a polypyrrole/polyquat complex with polyvinyl alcohol at a temperature of about 90 C, cooling to about room temperature, and then filtering through a filter.
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50. The process of Claim 49 wherein the poly(vinyl alcohol) is 100% hydrolyzed.

51. The process of claim 49 wherein the polyvinyl alcohol is
25 about 1% solubilized once the temperature becomes about room temperature.

52. The process of claim 50 wherein the polyvinyl alcohol is about 1% solubilized once the temperature becomes about room temperature.

30 53. The process of claim 49 wherein the filter is about a 0.45 micron filter.

54. The process of claim 49 wherein the films cast exhibit a conductivity of 10-3 S/cm.

5 55. The process of Claim 49 wherein the solubilized polypyrrole/polyquat complex is 3% solubilized.

56. The process of Claim 49 wherein the poly(vinyl alcohol) is applied to the polypyrrole/polyquat complex by spin coating, dip coating, or spray
10 coating.

57. An article of manufacture created by solubilizing a polypyrrole/polyquat complex with polyvinyl alcohol at a temperature of about 90 C, cooling to about room temperature, and then filtering through a filter.
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58. The article of manufacture of Claim 57 wherein the poly(vinyl alcohol) is 100% hydrolyzed.

59. The article of manufacture of Claim 57 wherein the
20 polyvinyl alcohol is about 1% solubilized once the temperature becomes about room temperature.

60. The article of manufacture of Claim 58 wherein the polyvinyl alcohol is about 1% solubilized once the temperature becomes about
25 room temperature.

61. The article of manufacture of Claim 57 wherein the filter is about a 0.45 micron filter.

30 62. The article of manufacture of Claim 57 wherein the films cast exhibit a conductivity of about 10-3 S/cm.

63. The article of manufacture of Claim 57 wherein the solubilized polypyrrole/polyquat complex is 3% solubilized.

5 64. The article of manufacture of Claim 57 wherein the poly(vinyl alcohol) is applied to the polypyrrole/polyquat complex by spin coating, dip coating, or spray coating.

65. The article of manufacture of Claim 59 wherein the
10 polypyrrole/polyquat complex is 3% solubilized.

66. A process for inserting a dopant of choice into a water-soluble polypyrrole matrix during synthesis comprising:

- 15 a.) mixing, with stirring, tetraethylammonium hydroxide to isopropanol to form a slurry, adding an equal volume of acetone to said slurry, filtering said slurry under a vacuum to obtain a resulting powder, said resulting powder is then washed and dried;
- b.) said washed and dried resulting powder is then resolubilized to form about a 3% solution;
- 20 c.) an acid containing an anion to be incorporated into the polymer is then added to said about 3% solution, stirring overnight at room temperature, adding a sufficient amount of polyvinyl alcohol and then filtering this product solution.

25 67. The process of Claim 66 wherein the mixing, with stirring, of tetraethylammonium hydroxide to isopropanol occurs for about ten minutes.

68. The process of Claim 66 wherein the resulting powder is washed in isopropanol/acetone two times followed by a final wash in acetone.
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69. The process of Claims 66 wherein the resulting powder is dried overnight on a vacuum at about room temperature.

70. The process of Claim 66 wherein the pH of said 3% solution
5 was about 10.

71. The process of Claim 66 wherein the thin films cast from said 3% solution exhibit a conductivity of 10^{-5} S/cm.

72. The process of claim 66 wherein the ratio of pyrrole to anion
10 is about 4 to about 1.

73. The process of Claim 66 wherein the polyvinyl alcohol is a 5% solution of 100% hydrolyzed polyvinyl alcohol, 86kDa, and a sufficient
15 amount is added to obtain a final concentration of 1% polyvinyl alcohol.

74. The process of Claim 66 wherein said product solution is filtered through about a 0.45 micron filter

75. The process of Claim 66 wherein the films cast from said product solution after filtering and drying exhibit a conductivity of 10^{-3} to 10^{-5} S/cm.
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76. The process of Claim 68 wherein the resulting powder is
25 dried overnight on a vacuum at about room temperature.